ZOOLOGY.—*Two new ostracods of the genus* Entocythere *and records of previously described species.*[1]

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At the time of publication of the writer's previous paper (1942) establishing the subfamily Entocytherinae of cytherid ostracods and describing two new species of the genus *Entocythere* epizoic on crayfishes, it seemed apparent that further examination of crayfishes would reveal other undescribed species of the group. At that time the writer had in his possession a few poorly prepared specimens of an undescribed species of the genus *Entocythere*. Upon examination of large numbers of specimens taken in recent collections, this undescribed form has been found in sufficient numbers to merit description. The present paper describes this as a new species, as well as a second new species. The opportunity is taken here to list records of previously described species of *Entocythere* from crayfishes collected in several States of the lower Mississippi Valley.

The bulk of material upon which this study is based was obtained from crayfishes collected by the writer during the spring of 1942 from areas in Illinois, Tennessee, Louisiana, and Arkansas. The crayfishes obtained from Tennessee were collected with the assistance of Prof. C. L. Baker while the writer was working at the Reelfoot Lake Biological Station under a research grant from the Tennessee Academy of Science. The crayfishes from Illinois were identified by the writer, and all the others were identified by Dr. Horton H. Hobbs, Jr., University of Florida. This study was aided by a grant from the American Association for the Advancement of Science through the Illinois State Academy of Science.

For a discussion of the ostracods epizoic on crayfishes and diagnoses of the subfamily Entocytherinae, the genus *Entocythere*, and the subgenera of the latter, the reader is referred to the paper by Hoff (1942).

Entocythere (Cytherites) riojai, n. sp.

Fig. 1

The type material was taken from several crayfishes of the species *Orconectes virilis* (Hagen) collected from a stream in South Park, Quincy, Adams County, Ill., on April 18, 1942. Holotype (female), allotype, and a number of paratypes, U.S.N.M. 81292. Additional paratypes have been retained provisionally in the writer's collection. The female selected as holotype was taken while in copulation, the male of the pair being the allotype. The paratypes include both gravid and copulating females, since the two kinds differ in several ways. It might appear inadvisable to select as the holotype a copulating, nongravid female rather than a gravid one, but, when the male and female of a copulating pair are selected as the first types, there is little possibility of designating as holotype and allotype individuals of different species.

This new species is named in honor of Dr. Enrique Rioja, an outstanding Mexican taxonomist, who has recently described two new species of the genus *Entocythere* (Rioja, 1940, 1942). Dr. Rioja was the first to discover the presence of two kinds of females in species of the genus *Entocythere*.

Female. The shell (Fig. 1, *A*) of the copulating female is ovate-oblong in general shape, with little irregularity in outline as seen from the side. The anterior end is more narrowly rounded than the posterior, since the greatest height is near the center of the posterior one-half of the shell. The dorsal margin is weakly convex, while the ventral margin presents a shallow concavity at about the anterior one-third. In some individuals this concavity is so poorly developed that the ventral margin is practically straight. Posterior to the concavity the ventral margin is slightly convex. The very fine marginal hairs of the shell are few in number and are evenly spaced along the ventral and end margins of the shell. The anterior one-third of the shell is unmarked and transparent. The posterior two-thirds, the part beginning a short distance posterior to the eye, is usually marked by very fine pits and colored by aggregations of pigment flecks. These flecks are often concentrated in two areas: one near the center of the dorsal margin extending ventrally toward the center of the shell and the other

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close to the posterior margin of the shell. In a few individuals the flecks have been observed to cover most of the posterior two-thirds of the shell, but, even in this case, there are always concentrations of pigment in the two areas already described. The eye is large in all individuals and is located about one-fifth of the distance from the anterior end of the shell.

Below are given measurements of several shells of copulating females cleared in xylol and mounted in clarite. These measurements are of females found in copulation at the time of capture.

Length	*Height*	
0.35 mm	0.19 mm	(holotype)
0.34	0.19	(paratype)
0.35	0.19	(paratype)

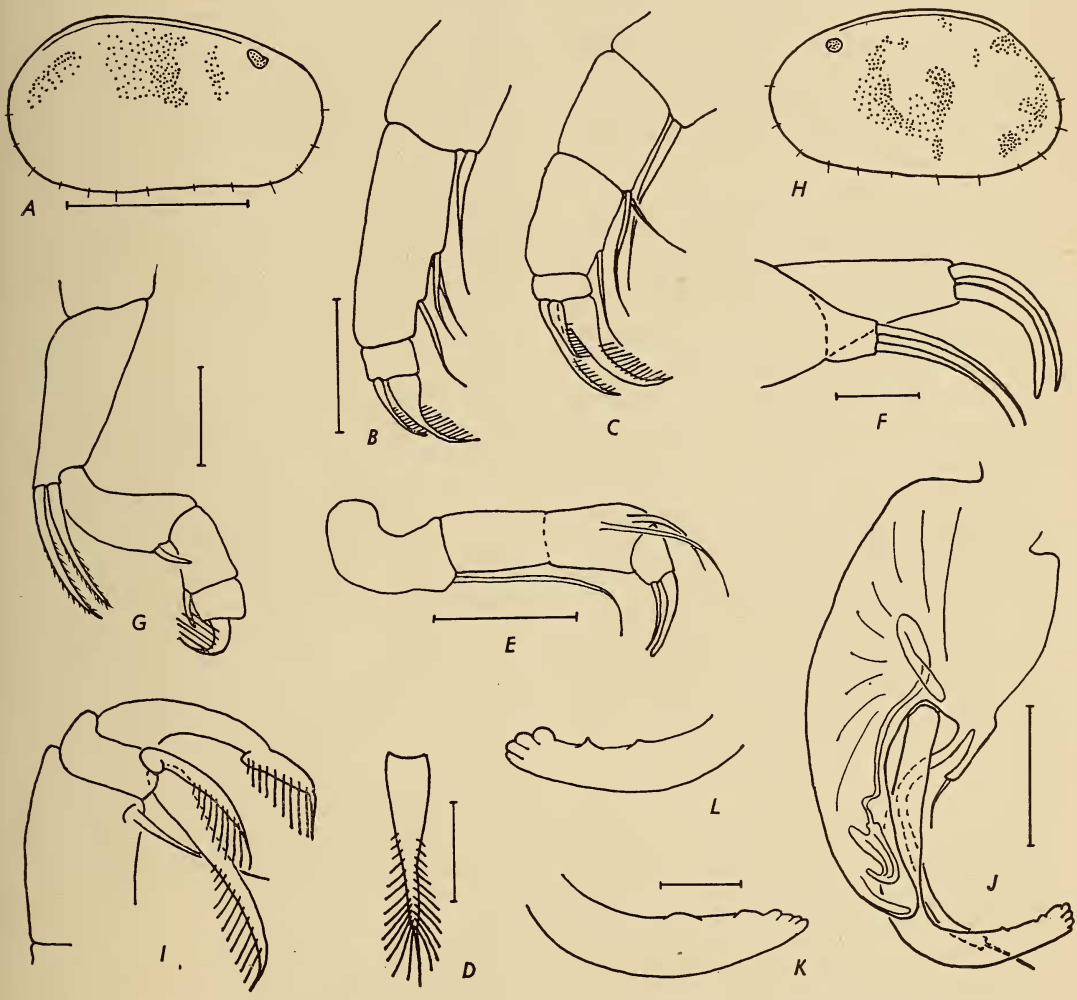

Fig. 1.—*Entocythere riojai*, n. sp.: *A*, Shell of female holotype as viewed from the right; *B*, distal part of antenna of copulating female paratype; *C*, distal part of antenna of gravid female paratype; *D*, ventral claw of the antenna of a male paratype seen from the flexor side; *E*, lateral view of the mandibular palp of a gravid female paratype; *F*, mesial view of the maxillary palp and protopodite of a gravid female paratype; *G*, lateral view of first leg of gravid female paratype; *H*, shell of male allotype viewed from the left; *I*, mesial view of the distal portion of the antenna of a male paratype; *J*, mesial view of the copulatory organ of the left side of a male paratype; *K*, the distal end of the "clasping appendage" of the male allotype; *L*, the distal end of the "clasping appendage" of a male paratype.

All figures were drawn from specimens mounted in clarite. A camera lucida was used. The scale in *A* equals 0.2 mm and applies also to *H*. The scale in *B* equals 0.02 mm and applies as well to *C*. The scale in *D* equals 0.01 mm and applies also to *I*. The scale in *E* equals 0.025 mm; that of *F*, 0.01 mm; that of *G*, 0.025 mm; and that of *J*, 0.025 mm. The scale in *K* is equal to 0.01 mm and also applies to *L*.

Measurements of females from other localities show considerable variation in shell size, with a tendency in many cases for the shells to be somewhat smaller than those of the type collection.

The shell of the gravid female is very similar to that of the copulating type already mentioned, except that the concavity of the ventral margin is much more pronounced and the size of the shell is about 10 percent greater, the length ranging from 0.35 to 0.40 mm or slightly more with the height proportional. Eggs can usually be observed in the gravid type of female but were not seen in copulating females. The eggs range in number from one to four, with two or three the usual number.

With the exception of the antennae, the appendages of the copulating and gravid females are identical in nature. Each antennule is composed of six podomeres. The width of the podomeres decreases in order from proximal to distal. The third podomere is almost square in lateral view, the more distal ones becoming cylindrical. The terminal podomere is the slenderest, having a length between four and five times the central width. The two basal podomeres each appear to bear a single seta; the third two setae; the fourth five somewhat shortened setae, few of which in any individual extend much beyond the level of the tip of the ultimate podomere of the appendage; the penultimate or fifth podomere has no seta; while on the ultimate podomere there are five setae, none of which has a length greater than three times the length of the supporting podomere.

The chief differences between the two kinds of females are to be found in the antennae. Each antenna in the female is composed of four podomeres exclusive of the exopodite or flagellum, which extends to a level with the end of the terminal claws of the appendage. The antepenultimate podomere of the antenna or the first podomere of the endopodite bears on the flexor-distal corner a long, heavy seta, which extends nearly to the level of the origin of the most distal seta of the penultimate podomere. The penultimate podomere of the copulating female (Fig. 1, *B*) is undivided, but in the gravid female (Fig. 1, *C*) a division occurs, so that the antenna appears to be formed of five podomeres, exclusive of the exopodite. In the copulating female the penultimate podomere has three setae, two forming a pair near the center on the ventral or flexor surface of the appendage and the third a short distance from the distal margin on the flexor surface. The most distal seta of the penultimate podomere has a length somewhat greater than the central width of the podomere, while each seta of the more proximally situated pair has a length about equal to the width of the podomere. In the gravid female the divided penultimate podomere bears a pair of setae on the distal-flexor corner of the basal portion. Another seta is located on the flexor margin of the distal portion about one-third of the distance from the distal end. Each of these three setae is as long as or longer than the basal portion of the podomere. In general, the setae of the antenna are somewhat longer in the gravid than in the copulating female. The ultimate podomere in both kinds of females is small, serving merely as articulation area for the terminal claws. The copulating female has two claws, a large ventral or posterior claw with a row of spinelike teeth passing along both sides and around the distal end as in the male (Fig. 1, *D*), having the appearance from the side, however, of a single row of teeth. These teeth or spines are stout on the distal portion of the claw but become somewhat shortened and weakened near the base. The anterior or dorsal claw is very slender, shorter than the other, and has a few poorly developed spines on the concave surface. The antenna of the gravid female bears three terminal claws, since in addition to the two described for the copulating female there is a third located mesially between the bases of the larger claws. This third claw is small and a little less than one-half the length of the dorsal claw of the antenna. It bears a few weak, short teeth.

The mouth parts are similar in both kinds of females. The mandibles have five to seven, usually six, flattened, spatulalike, multiple-cusped teeth. Two or three small additional teeth may be found in some individuals. The most distal tooth is much wider than the others and has six or seven cusps; the more proximal teeth being progressively smaller and exhibiting fewer cusps. The respiratory plate is reduced to three setae. The palp (Fig. 1, *E*) is composed of four podomeres. The joint between the basal

and the next or antepenultimate podomere of the palp is, however, weakly expressed, while the suture between the antepenultimate and the penultimate podomeres can not be discerned except under optimum conditions. The distal-flexor margin of the basal podomere supports a long, curved seta reaching to the distal end of the ultimate podomere; the antepenultimate podomere has no setae; the penultimate has two setae, a short one near the distal-extensor corner and a somewhat laterally placed longer seta originating from the anterior one-third of the podomere; the ultimate podomere bears terminally a heavy, slightly curved spine at the base of which is inserted a heavy seta nearly equal in length to the length of the spine. The maxilla (Fig. 1, *F*) has an unjointed palp extending far beyond the distal end of the protopodite and ending in two claw-like spines, each falciform, but the ventral one slightly longer and heavier than the other. The two are nearly parallel throughout their length. The base or protopodite ends in two long, stiffened setae, each somewhat longer than the terminal spine of the palp. The respiratory plate usually has 17 setae or rays, although it is very difficult to make an accurate count since the long and slender setae are extremely transparent and can be seen only in preparations made and examined with more than ordinary care. In the case of dissections the respiratory plate is often pulled loose from the protopodite, since the attachment is by a very slender basal stalk. For these reasons the respiratory plate easily may be overlooked.

Each of the three thoracic legs is composed of four podomeres. The first thoracic leg (Fig. 1, *G*) has two plumose setae at the anterior-distal corner of the first podomere. These setae are nearly equal in length, each being almost as long as the next more distal podomere. A single slightly plumose seta is found at the anterior-distal corner of the basal podomere of each leg of the second and third pairs. Each seta has a length not much more than one-half of the length of the antepenultimate podomere. The second podomere of each leg bears a single seta on the anterior margin of each leg a short distance removed from the distal margin. The length of this seta shows considerable variation but in general is not less than one-half of the width of the podomere at the base of the seta or more than the width of the podomere. The penultimate podomere is distally somewhat widened and meets the ultimate podomere in a poorly marked, probably little movable, joint. The penultimate podomere of each leg bears on the anterior distal corner a seta that has a length approximate to the length of the ultimate podomere. This seta is often so closely appressed to the anterior margin of the distal podomere that it is seen with difficulty. The ultimate podomere of each leg is wider than long. When the terminal claw is flexed the seta of the penultimate podomere contacts the teeth or spines of the terminal claw. Each of the terminal claws bears, on the average, five long teeth.

Male.—Shell of the male (Fig. 1, *H*) differing from that of the copulating female only by a ventral margin slightly convex throughout its length and a posterior margin flattened along the dorsal one-half. The measurements of several males mounted in clarite are as follows:

Length	*Height*	
0.33 mm	0.18 mm	(allotype)
0.34	0.18	(paratype)
0.32	0.18	(paratype)
0.37	0.19	(paratype)

The appendages differ in a few respects from those of the female. The chief difference between individuals of the two sexes is in the antenna, which in the male is modified for clasping the female during copulation. As in the gravid female, the penultimate podomere of the antenna is divided so that the appendage has five apparent podomeres. The setae of the antenna are placed in the same position but are relatively shorter than those of the gravid female. Like the gravid female, there are three end claws (Fig. 1, *I*). These claws are slightly longer than in the gravid female, the ventral claw especially being slenderer and lacking the bulbose basal portion observed in the corresponding claw of the gravid female. The anterior dorsal claw has a length equal to about three-fourths of the length of the longer but slenderer ventral claw. This dorsal claw is heavy throughout its length, is gently curved, and ends distally in a flattened, widened area, which bears a circular row of long teeth or spines that pass around the sides and end, the teeth appearing in side view like the teeth of a comb. The small mesial claw has a length equal

to about one-half of the anterior or dorsal claw. The mouth parts of the male are similar to those of the female. The thoracic legs differ only in the relative lengths of some of the setae, of which those of the antepenultimate podomeres seem usually to be longer in the male than in the female, each having a length greater than the width of the leg at the base of the seta.

The copulatory organ (Fig. 1, *J*) in the male consists of a base and three accessory pieces. The base is proximally widened but abruptly narrowed near the center of the anterior margin at the point of attachment of the accessory pieces. The most dorsal of the three accessory pieces has a short base and a single straight distal seta almost equal in length to the base. The next or center accessory piece is long and slender, being curved at each end but more or less straightened centrally. This accessory piece ends in a seta equal in length to the seta of the first accessory piece. The third or most distal accessory piece (Fig. 1, *K* and *L*) is heavy and falciform. This structure is often called the "clasping appendage." The end of this accessory piece is blunt and distally marked by three or four rounded teeth. The concave margin is toothed with usually two, rarely three, widely separated, almost papilliform teeth. The "clasping appendage" extends for some distance beyond the base of the copulatory organ.

Remarks.—At the present time, it would be difficult to attempt a discussion of the natural relationships of the species in the subgenus *Cytherites* Sars, 1926, especially since the male of *Entocythere* (*Cytherites*) *insignipes* (Sars, 1926), the type of the subgenus *Cytherites*, is unknown. The subgenera of the genus *Entocythere* seem poorly defined, and the entire classification of forms within the genus needs to be reviewed. It is even difficult now to indicate in some of the species a convenient combination of characteristics that might serve as a basis for rapid recognition. Except on the basis of the characteristics of the "clasping appendage," of the male copulatory organ, many of the species of the subgenus may be accurately separated from one another only by careful and detailed study. In the various species of the genus *Entocythere*, there are a few characteristics which, when carefully applied, serve to separate other species from *E. riojai*. As an aid to future work, a list of the known species of the genus is given here along with an indication of the way in which each may be separated from *E. riojai*.

Entocythere cambaria Marshall, 1903, *E. illinoisensis* Hoff, 1942, and *E. claytonhoffi* Rioja, 1942, differ from *E. riojai* by being much greater in shell length, about 0.60 mm, and by having fewer setae in the respiratory plate of the maxilla. These forms have been assigned to the subgenus *Entocythere* Marshall, 1903, as diagnosed by Hoff (1942).

E. insignipes (Sars, 1926) differs from *E. riojai* by having seven podomeres and three terminal setae in the antennule, while the latter has six podomeres and five terminal setae. The male copulatory organ of *E. insignipes* is undescribed, the original description of the species being based entirely upon female specimens.

Both *E. heterodonta* Rioja, 1940, and *E. donnaldsonensis* Klie, 1931, differ from *E. riojai* by the absence of a seta on the penultimate podomere of each thoracic leg. Neither species has a long, falciform "clasping appendage" with a regular, entire convex surface that could be confused with that structure in *E. riojai*.

E. columbia Dobbin, 1941, is easily separated from *E. riojai* by the size, about 0.60 mm in length, and the peculiar shape of the shell. There are also fewer setae in the respiratory plate of the maxilla according to a personal communication from Dr. Dobbin (Evenson). The "clasping appendage" is less curved than in *E. riojai*.

E. copiosa Hoff, 1942, may be separated with difficulty from *E. riojai* except by the "clasping appendage," which in the former has the convex margin subdistally divided in contrast to the entire convex surface of that structure in *E. riojai*. Also *E. copiosa* is slightly larger; the setae of the respiratory plate of the maxilla are stronger and more easily seen; and the teeth of the ventral claw of the antenna are usually weaker. These last characteristics are not, however, in every instance entirely dependable for separation of the two species.

E. humesi, the second species described as new in this paper, is much larger than *E. riojai* and has four terminal setae on the antennule and only two setae representing the respiratory plate of the mandible. The clasping appendage is not so long or curved as in *E. riojai*.

The problems of intrageneric and inter-

generic relationships in the Entocytherinae and the identification of species are further complicated by the occurrence in some species, as in *E. riojai*, of two kinds of females: the copulating and the gravid. Dr. Rioja in a personal communication to the writer has mentioned the presence of two kinds of females in a species of *Entocythere* from Mexico. Paris (1920) mentions two types of females, "nubile" and "ovigère," in the European species *Sphaeromicola topsenti* Paris, 1916, but does not discuss the two kinds in detail or account for their occurrence. Paris points out the shell differences, especially the increased size and angularity of the shell of the "ovigère" type of female, but mentions no differences in the antennae of the two kinds of females. In *E. riojai* the copulating females have the penultimate podomere of the antenna undivided and the antenna ending in two claws, while the gravid females have a divided penultimate podomere and three antennary claws.

An exact explanation of the occurrence of the two types of females can not be given at this time. In observations made on about 75 adult individuals, the majority of them females, it was noticed that all the females found in copulation were characterized by an undivided penultimate podomere in the antenna and two end claws. These have been designated as copulating females. None were observed in a gravid condition. On the other hand, practically all the larger females with the divided penultimate podomere and three end claws on the antenna were found to be carrying large, well-formed eggs. The females of this type never were observed in copulation.

On first noticing the two kinds of females, the writer supposed that he had discovered a case of parthenogenesis, since this phenomenon would explain the occurrence of copulation in the one kind of female and not in the other. Parthenogenetic development is known in many fresh-water ostracods, being common in species of the family Cypridae, but a morphological difference as exhibited here between females of the two kinds apparently is unreported. Observation does not substantiate the hypothesis that there is one type of female producing eggs requiring fertilization before development and another kind producing eggs developing without fertilization, since, if the hypothesis held, eggs should be observed in at least a few of the smaller females. Such eggs have not been found. The only adequate explanation for the two kinds of females seems to be that a molt occurs between the time of copulation and the time of development of the eggs within the ovary. At the time of this molt there appear the three claws and the divided penultimate podomere of the antenna as characteristic of the larger, gravid female. Whether this explanation is the correct one can be determined only by observation of the development of females in culture. Unfortunately, methods of culturing the epizoic ostracods are as yet undeveloped.

Ecology.—The lack of host specificity in the relationship between *E. riojai* and different species of crayfishes supports the writer's (1942) former observations. Three different species of crayfish are reported as being hosts to *E. riojai* in the six collections. These crayfish species are given in the paragraph on distribution.

In the six collections made of *E. riojai*, the species was found associated twice with *E. copiosa* and four times with *E. illinoisensis*. By this association is meant the finding of ostracods from the crayfishes of one collection and not from the same crayfish, since all the crayfishes of a collection are examined together as a single lot. *E. riojai* was found alone in two collections, but the absence of other forms from these two collections may be the result of small samples.

A review of the habitats, from which the material was secured, reveals the interesting fact that *E. riojai* has been found only on crayfishes from small streams where there is considerable current and never from the quiet waters of lakes or the larger, more slowly flowing streams. Large numbers of collections from different areas may make possible some interesting ecological deductions with reference to this and other species of *Entocythere*.

Distribution.—In addition to the type locality, where the species is very abundant, *E. riojai* has been found in collections as follows: a few individuals from *Orconectes virilis* (Hagen), Salt Fork at Homer Park, near Homer, Champaign County, Ill., on May 23, 1940; a few individuals from *Orconectes propinquus* (Girard) from Stony Creek, Oakwood, Vermilion County, Ill., September 19, 1940; a few individuals from *Orconectes propinquus*

(Girard) taken from the stream in Crystal Lake Park, Urbana, Champaign County, Ill., October 2, 1940; a number of individuals taken from *Orconectes longimanus* (Faxon) in a stream near Casa, Perry County, Ark., June 17, 1942; several individuals from *Orconectes meeki* (Faxon) from a stream near Crossroads, Pulaski County, Ark., on June 17, 1942.

Entocythere (Cytherites) humesi, n. sp.

Fig. 2

The type material was secured from a single slightly atypical male crayfish of the species *Cambarus bartonii robustus* Girard collected by Dr. Arthur G. Humes from a stream near Boston, Erie County, N. Y., on May 17, 1942. Holotype (female), allotype, and one paratype (female), U.S.N.M. 81293. Four paratypes, one male, one female, and two immature individuals, have been retained in the collection of the writer. This species is named in honor of the collector, Dr. Arthur G. Humes.

Female.—Shell from the side (Fig. 2, *A*) subreniform, with the posterior end higher and more broadly rounded than the anterior. The ventral margin of the shell has a shallow concavity deepest just behind the anterior one-third of the shell, while the posterior one-half of the ventral margin is weakly convex. The anterior end of the shell is narrowly rounded. The anterior margin meets the dorsal margin without interruption except for a slight indentation just ventral to the junction of the two margins. The dorsal margin is strongly arched with the highest point or apex located between the center and the posterior one-third of the margin. From the apex the dorsal margin slopes in an even arc both anteriorly and posteriorly. The posterior margin is dorsally somewhat flattened but ventrally rounded, meeting the ventral margin without angulation. In juvenile individuals a distinct protuberance or angulation is located at the posterior-ventral corner of the shell. The eye is well developed, is easily observed through the transparent valves, and is located near the anterior one-fifth of the shell. The valves appear asetaceous and show no important shell sculpturing. Poorly developed, scattered areas of pigment occur, however, on the dorsal one-half of each valve posterior to the eye. A more complete description of the shell is at present impossible because the material available for study is limited. Some indication of the shell size is shown by the following measurements of a gravid female paratype: length of shell, 0.50 mm; height at level of ventral concavity, 0.24 mm; greatest height, 0.29 mm.

With respect to the cephalic appendages, each antennule is composed of six podomeres. The first or basal podomere is heavy; the second has a length little less than twice the width; the third has a length about one and one-half times the width; the fourth or antepenultimate podomere is about twice as long as wide; the penultimate about as long as the antepenultimate but much slenderer; the ultimate is six to seven times as long as wide, with a length approximate to that of the next more proximal podomere. The basal podomere appears to bear a single seta on the ventral-distal corner, while the distal seta of the second podomere is somewhat mesial in position. The third podomere supports two setae. The antepenultimate podomere has four distal setae, one on the flexor margin and one on the extensor margin, with the other two mesial in position. These setae are long, some of them reaching slightly beyond the base of the terminal setae of the appendage. The fifth or penultimate podomere does not bear setae, but four terminal setae are located on the ultimate podomere of the antennule. The antennae closely resemble the antennae of several other species of the subgenus *Cytherites* Sars, 1926, each being composed of four podomeres, exclusive of the exopodite, and ending in two claws (Fig. 2, *B*). The penultimate podomere is undivided. The anterior or dorsal terminal claw is weak, with the teeth so poorly developed that they are seen only with great difficulty. The ventral claw is the larger, is proximally bulbose, and has a comblike row of long teeth along the distal two-thirds of the claw. The penultimate podomere of the antenna has a length nearly equal to three times the average width of the podomere and bears three setae on the flexor or ventral margin. One of these is removed a short distance from the distal end of the podomere, and the other two form a pair slightly anterior to the center. Each has a length almost equal to the width of the podomere at the base of the seta. The seta of the flexor-distal corner of the antepenultimate podomere has a heavy basal por-

tion and does not reach the level of the origin of the most distal seta of the penultimate podomere. The antepenultimate or second podomere of the antenna (the basal podomere of the endopodite) has a distal width approximate to the length of the ventral margin. The flagellum or exopodite reaches to the level of the terminal claws of the endopodite. The protopodite of the mandible bears six spade-like or spatulaform teeth, the mesial two usually being longer than the others and having a single cusp, while the more laterally placed teeth are multicusped, the outside one having six well-developed denticles or cusps. In some instances a small but rudimentary additional tooth may be found mesial to the others, thus making seven teeth in all. A short distance proximal to the teeth the protopodite bears a short, heavy seta on the convex or anterior surface. This seta is directed toward the distal end of the protopodite. The respiratory plate is represented by two setae: one more than one-third as long as the mandibular palp, the other about one-fourth the length of the palp. In some individuals one of these setae appears to be directed mesially, usually closely appressed to the protopodite, while the shorter of the two setae often stands erect. These setae are fleshy in appearance, the bases being widened, and they appear to originate from a small papilla. The mandibular palp (Fig. 2, *C*) of four podomeres extends distally beyond the protopodite. In this palp the juncture of the basal and second podomere is not well marked but can be located by noticing the origin of the seta at the distal-flexor corner of the basal podomere. This seta reaches the level of the ultimate podomere of the palp. The straight basal two-thirds of the seta is often directed parallel to the flexor margin of the palp, while the distal one-third is evenly curved. The probably inarticulate juncture of the antepenultimate or second and the penultimate or third podomere is too weak to be easily observed. On the anterior face, slightly removed from the distal end of the penultimate podomere, is a gently curved seta extending almost to the tip of the terminal spine of the ultimate

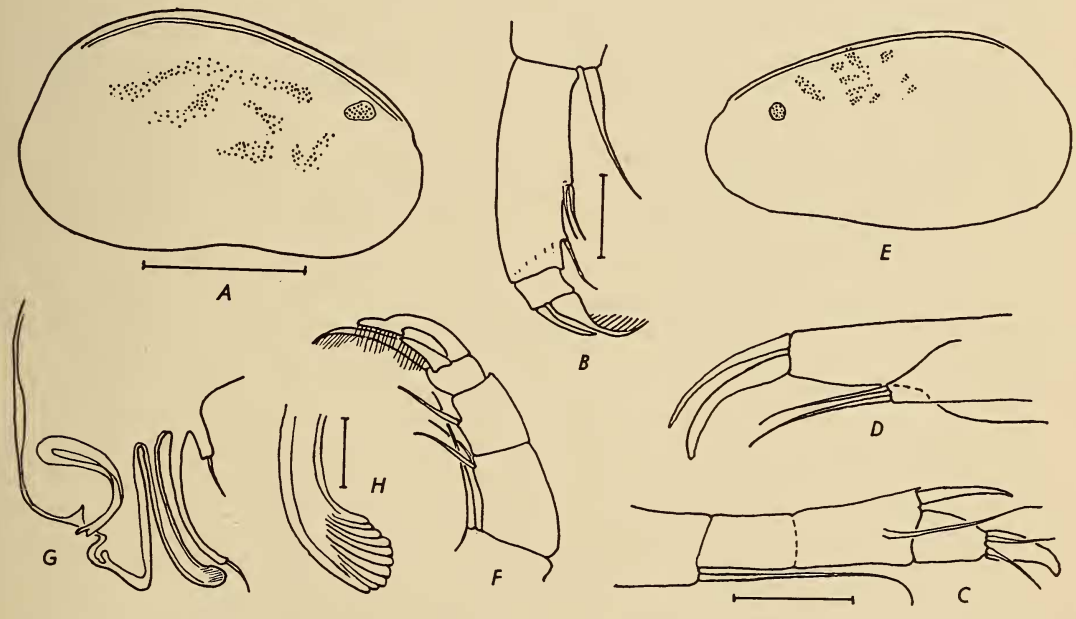

Fig. 2.—*Entocythere humesi*, n. sp.: *A*, Shell of a female paratype as seen from the right side; *B*, mesial view of the distal end of the endopodite of the antenna of a female paratype; *C*, anterior view of the mandibular palp of the holotype; *D*, mesial view of the masticatory process and the maxillary palp of a female paratype; *E*, shell of male allotype viewed from the left side; *F*, mesial view of the endopodite of the antenna of male allotype; *G*, lateral view of the distal end of the copulatory organ of male allotype; *H*, end of "clasping appendage" of male allotype.

All figures were drawn with the aid of a camera lucida from specimens mounted in clarite. The scale for *A* equals 0.2 mm and applies also to *E*. The scale for *B* equals 0.025 mm and applies as well to *F* and *G*. The scale for *C* equals 0.02 mm and may be applied to *D*. The scale for *H* is equal to 0.01 mm.

podomere, while at the extensor-distal corner of the same podomere is a sharply pointed, spinelike seta whose tip extends slightly beyond the distal end of the ultimate podomere. The terminal podomere is distally narrowed and has a flexor margin whose length is slightly greater than the basal width of the podomore. In addition to the heavy terminal spine, which is curved near the tip, the ultimate podomere bears two fine setae originating beneath the base of the spine. The spine has a length somewhat greater than the length of the extensor margin of the ultimate podomere, while each seta is somewhat shorter. In Fig. 2, *C*, the terminal podomere of the mandibular palp is shown slightly rotated to expose the two terminal setae, which are difficult to distinguish as separate setae when observed in lateral or mesial view. The maxilla (Fig. 2, *D*) includes a single masticatory process, an unsegmented palp, and a respiratory plate bearing 16 rays or setae. The unsegmented palp ends in a heavy but gently curved spine along the convex side of which runs a second similarly curved but slenderer spine, slightly shorter than the first. The single masticatory process terminates distally in two long setae, each curved gently near the tip and reaching some distance beyond the base of the terminal spine of the palp.

The three pairs of thoracic legs are similar, as each consists of four podomeres and terminates in a sickle-shaped claw displaying on the concave surface five teeth in addition to the one that is a continuation of the basal portion of the claw. The center teeth are considerably longer than the others. The legs differ chiefly in the presence of two setae at the anterior-distal corner of the basal podomere of the legs of the first pair but only a single seta in this position in the legs of the second and third pairs. The penultimate podomere of each leg has a single heavy, short seta on the distal anterior corner. The antepenultimate podomere supports a single seta on the anterior margin somewhat removed from the distal end of the podomere.

Male.—The shell of the male (Fig. 2, *E*) is similar in general shape to that of the female except that the concavity of the anterior portion of the ventral margin seems to be more weakly developed and may be so nearly wanting that the ventral margin appears practically straight. Redescription with an indication of the limits of variability of shell size and shape will be advisable when additional material can be secured for study. Two males mounted in clarite have shell measurements as follows: length, 0.45 mm; height behind eye at level of weak sinuation of ventral margin, 0.19 mm; and maximum height at the level of the apex of the dorsal margin, 0.24 mm.

The appendages of the male resemble those of the female. The podomeres of the antennules are not so wide, however, making them appear slightly slenderer in general aspect. The number and position of the setae are identical in the antennules of the two sexes. The antennae of the male (Fig. 2, *F*) present the characteristics associated with that sex. As is common among males of species of *Entocythere*, the penultimate podomere of the present species is so divided that each antenna appears to be composed of five podomeres. Two setae stand at the flexor-distal corner of the basal portion of the penultimate podomere, while a third seta is located on the ventral margin slightly anterior to the center of the distal portion. The antenna of the male terminates in three claws. The ventral claw is long and has very poorly developed teeth along only the terminal one-third of the concave surface. These teeth are much weaker than usual in males of species of this genus. The extreme tip of the ventral claw is bent ventrad. The dorsal or anterior claw is shorter and heavier than the first claw described and bears long teeth arranged comblike along the distally flattened margin. The third claw is mesial in position, being interposed in position between the bases of the other two claws. This third claw has a length equal to about two-fifths of the length of the ventral claw and just reaches the proximal limit of the flattened area of the dorsal claw. The teeth of the mesial claw are much better developed than the teeth of the ventral claw. Perhaps as a sexual difference, the seta of the basal podomere of the endopodite of the antenna reaches to the center of the ultimate podomere of the endopodite, being much longer than the corresponding seta in the female. With respect to the mouth parts, the limited material available makes impossible accurate checking of all details pertaining to the mandible of the male. There seems, however, to be close agreement in structure of the mandible in the two sexes. It was clearly seen that the

distal end of the ultimate podomere of the mandibular palp of the male bears a long, heavy, gently curved spine close to the base of which originate two slender, short setae. The maxilla of the male allotype appears to have a respiratory plate bearing 17 rays or setae. The setae of the respiratory plate could not be counted accurately on the male paratype available. The slight variation of the allotype from the 16-rayed condition observed in the female holotype is no more than can be expected as an individual difference. No essential differences were noticed between the thoracic legs of the female and the male.

The copulatory organ (Fig. 2, *G*) differs distinctly from that of other known *Entocythere* species. The base of this structure terminates in a well-chitinized, truncate lobe. The base supports three accessory pieces, of which the dorsal is fleshy in appearance and consists of a short base and a long, slender terminal spine. The second or middle accessory piece has a much longer base directed distally and anteriorly, extending just beyond the end of the base of the copulatory organ. The second accessory piece is terminated by a slender, curved spine approximate in length to the spine of the first accessory piece. The third accessory piece or "clasping appendage" (Fig. 2, *H*) is sickle-shaped or falciform, curved more distally than proximally, and formed of a highly chitinized bar, distally widened and fan-shaped, marked terminally by longitudinal corrugations or grooves. This "clasping appendage" reaches almost to a level with the end of the spine of the second accessory piece.

Remarks.—*Entocythere humesi* may be separated from other species of the genus *Entocythere* by no single characteristic except the shape of the "clasping appendage" of the male copulatory organ. A combination of characteristics will serve, however, in the case of the female, for separation of *E. humesi* from other described species. This is the only species that has a combination in the female of four terminal setae on the antennule, an undivided penultimate podomere in the antenna, and two respiratory setae representing the respiratory plate of the mandible.

Distribution.—Known only from the type locality.

Entocythere copiosa Hoff, 1942

In 1942, the present writer reported *E. copiosa* as abundant from a number of different species of crayfishes collected from several localities in Illinois. The present study reveals the occurrence of this species in many collec-

TABLE 1.—COLLECTIONS OF THE EPIZOIC OSTRACOD ENTOCYTHERE COPIOSA

Date	Crayfish host	Habitat	Location
14–VI–1942	*Procambarus clarkii* (Girard) *P. blandingii acutus* (Girard)	Roadside ditch	Near Port Allen, West Baton Rouge Parish, La.
14–VI–1942	*P. clarkii* (Girard)	Roadside ditch	Near White Castle, Iberville Parish, La.
15–VI–1942	*P. blandingii acutus* (Girard)	Roadside ditch	Near Alexandria, Rapides Parish, La.
15–VI–1942	*P. hinei* (Ortmann) *P. clarkii* (Girard)	Roadside ditch	Near Livonia, Pointe Coupee Parish, La.
15–VI–1942	*P. blandingii acutus* (Girard) *P. clarkii* (Girard)	Roadside ditch	Near Westover, West Baton Rouge Parish, La.
16–VI–1942	*P. blandingii acutus* (Girard) *Orconectes clypeata* (Hay)	Roadside ditch	Near Dry Prong, Grant Parish, La.
17–VI 1942	*Orconectes meeki* (Faxon)[1] *P. blandingii acutus* (Girard)	Stream	Ivesville, Pulaski County, Ark.
25–VI–1942	*P. clarkii* (Girard)	Bayou	Walnut Log, Obion County, Tenn.
26–VI–1942	*P. clarkii* (Girard)	Bayou	Walnut Log, Obion County, Tenn.
13–VII–1942	*P. clarkii* (Girard)	Bayou	Walnut Log, Obion County, Tenn.
20–VII–1942	*P. clarkii* (Girard)	Lake	Lake Center, Obion County, Tenn.
25–VII–1942	*Cambarus d. diogenes* (Girard) *Orconectes i. immunis* (Hagen)	Stream	South of Walnut Log, Obion County, Tenn.
25–VII–1942	*O. i. immunis* (Hagen)	Small stream	South of Walnut Log, Obion County, Tenn.
25–VII–1942	*O. i. immunis* (Hagen)	Pool in stream bed	Near east side of Reelfoot Lake, Obion County, Tenn.
25–VII–1942	*Procambarus clarkii* (Girard)	Small stream	Near east side of Reelfoot Lake, Obion County, Tenn.

[1] Males of *O. meeki* in this collection reported as slightly atypical.

tions from widely separated areas in Louisiana, Arkansas, and Tennessee. Data relative to these collections are given here in tabular form.

The data in the table show an apparent lack of habitat selection in the instance of this species, since the form is found in roadside ditches, pools, lakes, and various types of streams. This lack of habitat preference is in direct contrast to the condition mentioned with reference to *E. riojai.*

Entocythere illinoisensis Hoff, 1942

Besides the Illinois localities for *E. illinoisensis* given in the writer's paper of 1942, this rather infrequent species is now known from two localities in Arkansas. Near Casa, Perry County, Ark., a collection of 11 individuals of *Orconectes longimanus* (Faxon) produced several ostracods of the species *E. illinoisensis* in association with several specimens of *E. riojai.* The collection was made from a swiftly flowing stream on June 17, 1942. A second collection of *E. illinoisensis* was made on the same date from a small stream near Ivesville, Pulaski County, Ark. Two individuals, one male and one female, of this species were obtained from a collection of the crayfishes *Orconectes meeki* (Faxon) (males slightly atypical) and *Cambarus blandingii acutus* (Girard). Also in this collection were large numbers of *Entocythere copiosa.*

Like *E. riojai,* the present species favors stream habitats and in most cases has been collected from streams where there is considerable current. This is shown not only by the present records but also by the several previous records (Hoff, 1942).

In the collection from near Ivesville, Ark., the female agrees in detail with type specimens, but the male is somewhat atypical, since the pronounced knob or projection on the convex side of the "clasping appendage" of the male copulatory organ is greatly reduced. The "clasping appendage" is otherwise not abnormal, resembling in detail typical individuals of *E. illinoisensis.* The modified "clasping appendage" of this atypical male to some small degree resembles that of *E. cambaria* Marshall 1903, but other body structures are certainly not those of *E. cambaria.* For the present, until more material can be procured, this specimen will be assigned to *E. illinoisensis.* Upon the acquisition of additional material, it will be possible to show either that this one individual is abnormal or that a new species or subspecies is represented.

SUMMARY

1. Two species of the genus *Entocythere,* *E. riojai* from Illinois and Arkansas and *E. humesi* from New York, are described as new.

2. Locality records extending the geographical ranges of *E. copiosa* and *E. illinoisensis* are given.

3. *E. riojai* and *E. illinoisensis* have been found to occur only on crayfishes from small streams where there is considerable current. *E. copiosa* apparently does not show any habitat preference.

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